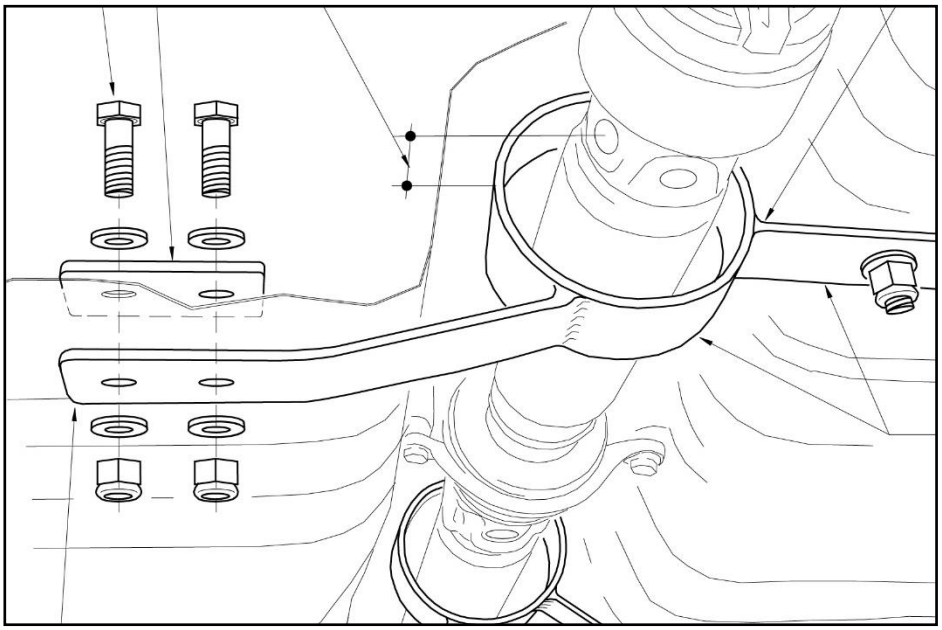
Drive-shaft Safety-loop Requirements

Introduction:

The purpose of this drive-shaft safety-loop information sheet is to provide information to vehicle modifiers about the requirements and specifications for drive-shaft safety loops, and to provide examples and clarification on all other aspects of drive-shaft safety loop requirements.



Requirements:

When are drive-shaft safety-loops required?

A drive-shaft safety-loop must be fitted around the forward end of each section of drive-shaft on any low volume vehicle that is of a front-engine and rear-wheel drive configuration, and which incorporates an open drive-line, if:

- the vehicle has had an engine conversion that has resulted in a significant increase in power or torque; or
- the vehicle has had its factory-fitted engine significantly modified, such that a significant increase in power or torque has resulted; or
- the drive-shaft fitted to the vehicle is aftermarket including steel, carbon-fibre, aluminium or composite, or where the shaft has been modified by welding; or
- the vehicle has been fitted with a turbocharger, supercharger, or a nitrous system, unless the vehicle was originally fitted with a mechanical injector-pump equipped diesel engine and has been retro-fitted with a complete original equipment turbo system from the same make and model of vehicle.

Note: A 'significant increase in power or torque' in a low volume vehicle is considered to be over 50% of the vehicle's factory power output.

Why are they needed?

Drive-shafts spin incredibly fast causing a drive-shaft to contain enormous rotational forces, and in the event of a front yoke failure, the flailing drive-shaft can easily penetrate through the vehicle floor injuring vehicle occupants, or down into the road surface below. Both scenarios can lead to severe injury and/or loss of driver control - there have been fatalities on New Zealand roads caused by failed or disengaged drive-shafts. Drive-shaft safety-loops ensure that in the event of yoke failure or driveshaft disengagement (perhaps through a rear radius rod failure), the massive energy of the disengaged and rotating drive-shaft is contained. For this reason, the safety-loop and its attachment systems must be very well engineered.

Design:

The drive-shaft safety-loop must provide 360-degree enclosure of the drive-shaft and, should yoke failure occur, the safety-loop must not act as a cutting edge against the drive shaft. The safety-loop should also be as close to circular as practicable and as close to the drive-shaft as can be practically achieved whilst taking into account drive-shaft articulation and suspension movement. All welding must meet applicable requirements contained in section 18.7 of the Hobby Car Technical Manual.

Examples of effective drive-shaft safety-loop design can be found at the end of this document.

Material Specifications:

A drive-shaft safety-loop should be made from either flat-section material at least 50 mm x 5 mm, or tubular-section material of at least 22 mm x 3 mm.

Note: 5 mm is a common material thickness for commercially-manufactured drive-shaft safety-loops.

Location:

A drive-shaft safety-loop must be mounted within 250 mm rearward of the front drive-shaft universal pivot centre, unless a particularly short drive-shaft is fitted, in which case 150 mm rearward is acceptable.

Note: The New Zealand Hobby Car Technical Manual states that a drive-shaft loop must be mounted within 150 mm rearward of the front drive-shaft universal; however, it has since been agreed by the LVVTA Technical Advisory Committee to extend this measurement out to 250 mm. The New Zealand Hobby Car Technical Manual will be updated in due course; - until then, this Information Sheet takes precedence.

Attachment:

Drive-shaft safety-loops should be attached to or incorporated within a chassis or sub-frame rails, or a rigid cross-member. However, if this is not practicable, the safety-loop can be attached to the floor using doubler plates.

<u>Drive-shaft safety-loops attached to vehicle floor:</u>

In the case of a drive-shaft safety-loop which is attached to a vehicle floor, the safety-loop must be securely attached to the vehicle floor with two fasteners on each side of the drive-shaft safety-loop that are of a diameter no less than 10 mm (3/8”) and have the equivalent tensile strength of between grade-8.8 (grade-5 imperial) and grade-10.9 (grade-8 imperial) with nyloc nuts or spring washers.

Drive-shaft safety-loops attached to a vehicle floor must use one doubler plate on each side of the drive-shaft safety-loop with a minimum mating area of 3000 square mm. All doubler plates must be mounted as closely to square as practically achievable, have all corners rounded to a radius of no less than 5 mm, and have all edges which contact the vehicle structure to which the doubler plate attaches rounded by the

removal of no less than 0.1 mm of material. Where the mounting surface area of the drive-shaft loop is less than 3000 square mm, an additional doubler plate attached to the underside of the floor must be used.

Note 1: A typical plate size that meets the 3000 square mm requirement would be a 50 x 60 x 3 mm plate or larger.

Note 2: When a pair of doubler plates are used, it is recommended they be riveted together.

Drive-shaft safety-loops fitted to a chassis or sub-frame rail:

In the case of a drive-shaft safety-loop fitted to a chassis or sub-frame rail, the safety-loop must be securely attached with one or two bolts per side that are equal to or greater than the combined cross-sectional areas of two 10 mm (3/8") fasteners and have equivalent tensile strength of between grade-8.8 metric (grade 5 imperial) and grade-10.9 metric (grade-8 imperial).

Note: The combined cross-sectional area of two 10 mm (3/8") bolts is 157 mm2 (14 mm). To reduce the number of bolts per side to one per side, a vehicle modifier/builder will need to use at least 14 mm (9/16") bolts. Where only one fastener is used per side, the loop must be designed and installed in such a way that prevents the safety-loop from pivoting forward or backwards from the attachment points.

Exclusions/notes:

Hydraulic brake pipes:

A hydraulic brake pipe which is mounted adjacent to any drive-shaft in a low volume vehicle which is required to be fitted with a drive-shaft loop must be re-directed away from the vicinity of the drive-shaft, or protected from a drive-shaft failure by a 360-degree safety loop at each end of the drive-shaft, positioned within 150 mm rearward of the front drive-shaft universal pivot centre, and 150 mm forward of the rear drive-shaft universal pivot centre.

Multi-piece drive-shafts:

A vehicle that has a two or three-piece drive-shaft must have a drive-shaft loop fitted to all sections of the drive-shaft unless a drive-shaft hanger bearing is positioned directly behind a universal and the hanger will effectively contain a failed or disengaged driveshaft.

Note: All joints, regardless of their construction type, must be treated in the same way as universal joints when determining whether a drive-shaft loop is required.

Chassis and safety-loop combination:

A chassis member or section can substitute for a drive-shaft safety-loop provided that it is positioned no more than 250 mm rearward of the front drive-shaft universal pivot centre, provides 360 degree protection, and meets or exceeds the material specifications as detailed above.

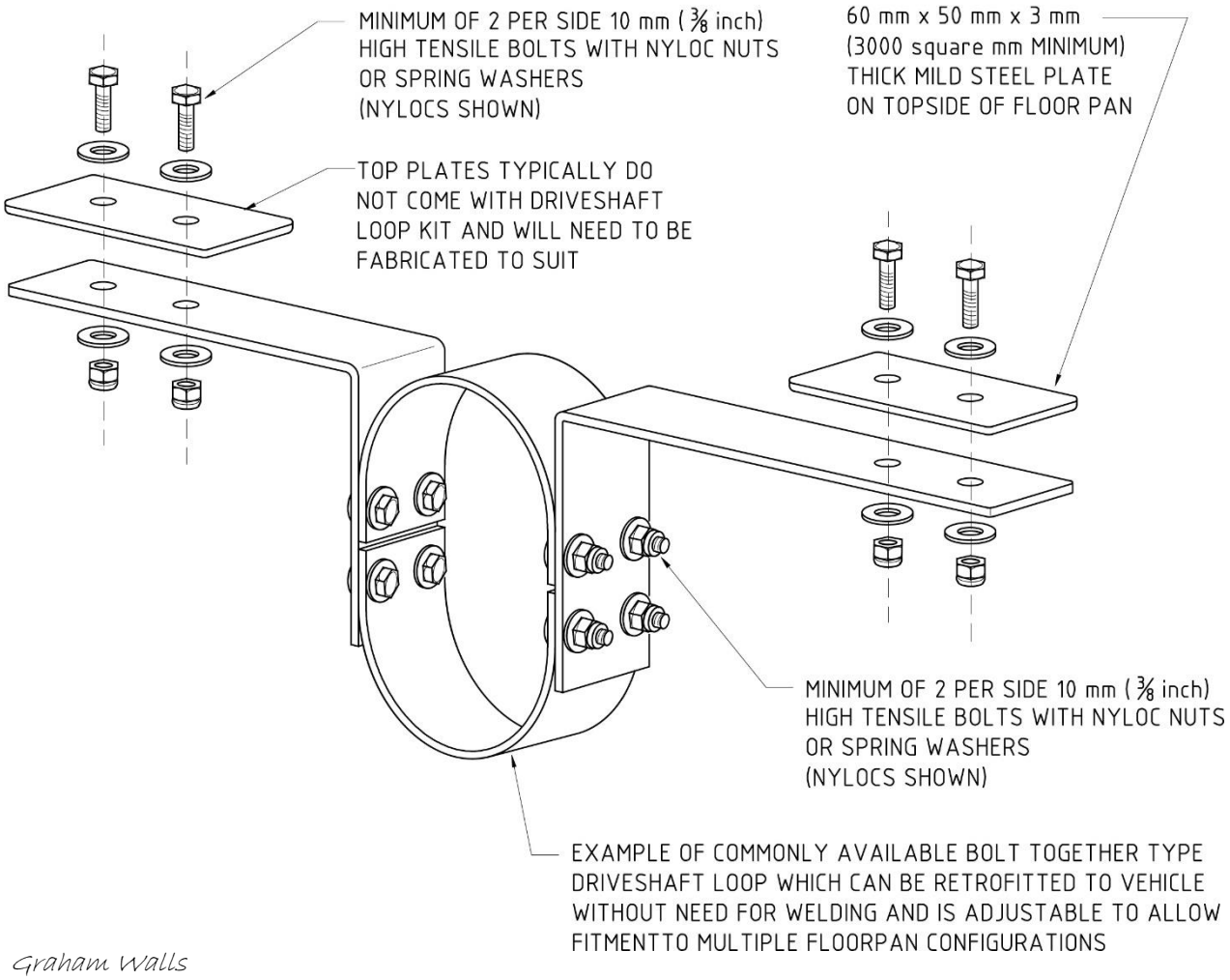
Front drive-shafts:

A front drive-shaft in a four wheel-drive vehicle is not required to have a drive-shaft safety loop, unless an unusual situation arises where a front drive-shaft is able to make contact with the road surface or critical mechanical components. In such cases vehicles should be dealt with by the LVV Certifier on a case-by-case basis.

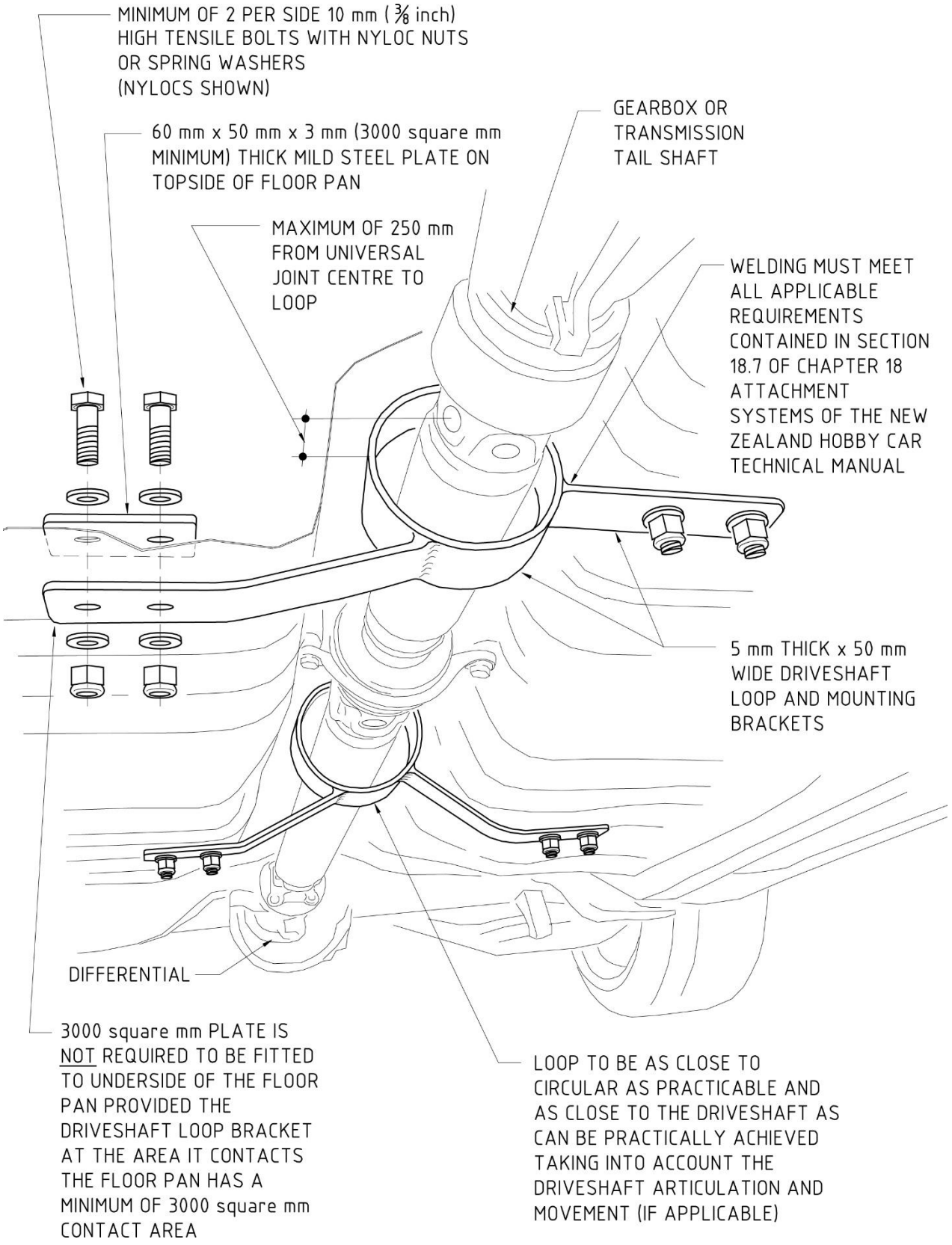
Interchangeable drive-shafts:

In the case of a vehicle which has had a bolt-in OEM (original equipment manufacturer) model variant engine or transmission conversion, or a bolt-in OEM model variant turbocharger/supercharger addition, a drive-shaft safety-loop is not required provided that documented proof is provided by the vehicle manufacturer or their agent, verifying that all drive-shaft components are identical between the two vehicles, and that the drive-shaft remains unmodified.

EXAMPLE OF COMMONLY AVAILABLE BOLT TOGETHER TYPE DRIVESHAFT LOOP



Graham Walls diagram


MINIMUM OF 2 PER SIDE 10 mm (⅜ inch) HIGH TENSILE BOLTS WITH NYLOC NUTS OR SPRING WASHERS (NYLOCS SHOWN)
60 mm x 50 mm x 3 mm (3000 square mm MINIMUM) THICK MILD STEEL PLATE ON TOPSIDE OF FLOOR PAN
GEARBOX OR TRANSMISSION TAIL SHAFT
MAXIMUM OF 250 mm FROM UNIVERSAL JOINT CENTRE TO LOOP
WELDING MUST MEET ALL APPLICABLE REQUIREMENTS CONTAINED IN SECTION 18.7 OF CHAPTER 18 ATTACHMENT SYSTEMS OF THE NEW ZEALAND HOBBY CAR TECHNICAL MANUAL
5 mm THICK x 50 mm WIDE DRIVESHAFT LOOP AND MOUNTING BRACKETS
DIFFERENTIAL
3000 square mm PLATE IS NOT REQUIRED TO BE FITTED TO UNDERSIDE OF THE FLOOR PAN PROVIDED THE DRIVESHAFT LOOP BRACKET AT THE AREA IT CONTACTS THE FLOOR PAN HAS A MINIMUM OF 3000 square mm CONTACT AREA
LOOP TO BE AS CLOSE TO CIRCULAR AS PRACTICABLE AND AS CLOSE TO THE DRIVESHAFT AS CAN BE PRACTICALLY ACHIEVED TAKING INTO ACCOUNT THE DRIVESHAFT ARTICULATION AND MOVEMENT (IF APPLICABLE)

Finally:

For any assistance in the use of this Information Sheet please contact an LVVTA technical team member at the Wellington LVVTA office on (04) 238 4343.